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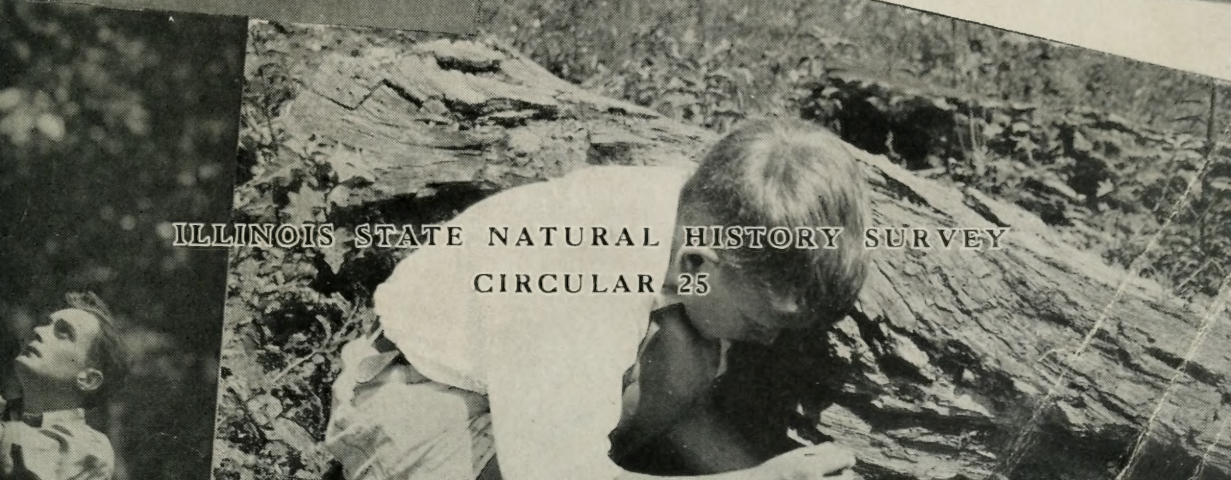
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HOW TO COLLECT AND PRESERVE INSECTS

H. H. ROSS

A close-up photograph of a hand holding a small beetle with a needle. The beetle is dark with light spots. The hand is positioned over a white card.

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A photograph of a child looking up, partially visible in the bottom left corner of the cover.

ILLINOIS STATE NATURAL HISTORY SURVEY
CIRCULAR 25

How to Collect and Preserve Insects

H. H. ROSS



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To The Collector

MANY BELIEVE that only a trained entomologist can make a worth-while collection of insects. This is by no means the case, for with rather simple equipment it is possible for almost anyone to do a good job of collecting and preserving these interesting little animals.

The principal values of making an insect collection are educational, recreational and scientific. Developing this hobby is one of the finest ways for students, especially in agricultural districts, to become acquainted with the large number of injurious and beneficial insects which they will encounter on the farm or about the home. Or high school classes in biology will find excellent material in the great many insects available for rearing and study. Old and young alike find a great deal of pleasure in collecting the more showy and beautiful insects such as beetles, moths and butterflies; the satisfaction derived comes both from having welcome relaxation from the day's work, and from making real contributions to scientific knowledge. Many entomological museums welcome the opportunity to examine or become informed upon individual, carefully prepared and labeled collections, as these supply distribution records for their localities as well as other information of value to professional interest. The collector profits, too, from his contact with authorities who can identify his specimens for him and advise him at any stage of his work.

It is hoped that this circular will show how easy it is to make a start in insect collecting, and will give the student helpful ideas on how and where to begin.

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HOW TO COLLECT AND PRESERVE INSECTS

H. H. Ross†

WHERE TO COLLECT

IN LATE SPRING, summer and fall, insects are very abundant in fields and woods, and large numbers of them may be caught by sweeping through the grass and branches with a strong insect net. Flowers of all descriptions are favorite visiting places of many bees, flies, beetles and other insects, and will afford good collecting. Woods along the banks of streams, open glades in deep woods and brush along forest edges offer some of the best opportunities for collecting by the sweeping method.

In early spring, when insects can be taken only sparingly in the open, one frequently finds sheltered hollows where they may be caught in large numbers. Many kinds of insects live only on a certain plant, and to obtain them one must search or sweep the host plant which the insect prefers.

Many obscure places harbor insects seldom found elsewhere. Among these are leaf mold and debris on the surface of the soil, particularly in woods; rotten logs and stumps,

*See note concerning the series at end of this Circular.

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which should first be turned over for insects which hide under or around them, and then carefully torn apart for others which actually live inside; in, under and around dead animals; under boards, stones and the like.

Trees sometimes yield valuable specimens. In collecting, part of a tree under which has been spread a large white sheet is struck with a heavy padded stick, and many insects in the branches, such as weevils, will fall to the sheet, play "possum" and can be picked off quite easily.

Lights attract large numbers of certain nocturnal insects such as June beetles and many kinds of moths, and at night these may be collected around street and porch lights, on windows and screens of lighted rooms, or at light traps put up especially to attract them. Swarms of aquatic insects come to street lights of towns along rivers, sometimes in such numbers as to pile up in a crawling mass under each light. Collecting at this source is best on warm cloudy nights; wind or cold keeps most nocturnal insects fairly inactive. Different species of moths and beetles visit the lights in different seasons so that collecting of this type alone throughout the year yields many kinds of insects.

Insects which live in the water may be collected by the use of heavy dip nets, swept through the water at various levels and through the mud and debris at the bottom. In shallow water stones and logs should be turned over, and leaf tufts pulled apart.

In winter insect galls or cocoons may be gathered and placed in jars with a cheesecloth cover tied over them. If these are kept in a warm room but away from radiators and all intense heat many insects will emerge from them before spring.

WHAT TO USE

FOR making even a fairly large insect collection only a small amount of collecting equipment is required. A net

and killing bottle are essential, and good work may be done with these alone. A greater variety of insects may be collected and with better results if a few more items are added to the list. Here is an outfit that will be found very satisfactory in the field.

1. A strong beating net and an additional light net to be used for moths and butterflies.
2. Killing bottles, several small and one or two large.
3. A pair of flexible forceps 10-12 centimeters (about 4-5 inches) long, with slender prongs.
4. One or two camel's hair brushes for picking up minute insects.
5. A few vials or small bottles containing fluid preservative.
6. Folded papers for butterflies.
7. A few small tins or boxes lined with cellulocotton.

These items may be purchased from commercial supply houses such as those listed on page 24. Many items, however, may be made by the collector at nominal cost. Forceps, brushes, bottles, chemicals, wire and fabric must be purchased, but nets, killing bottles and accessories may readily be made from these raw materials.

NETS

Their Construction.—Nets may easily be made at home. The necessary parts are a handle, a hoop or ring attached to it and a cloth bag hung from the ring (Figs. 1 and 2). The handle should be strong and fairly light. At the net end (Fig. 1, *a*) a groove is cut down each side to receive the hoop. These grooves are as deep as the thickness of the wire used in the hoop; one is 3 inches long and the other $2\frac{1}{2}$

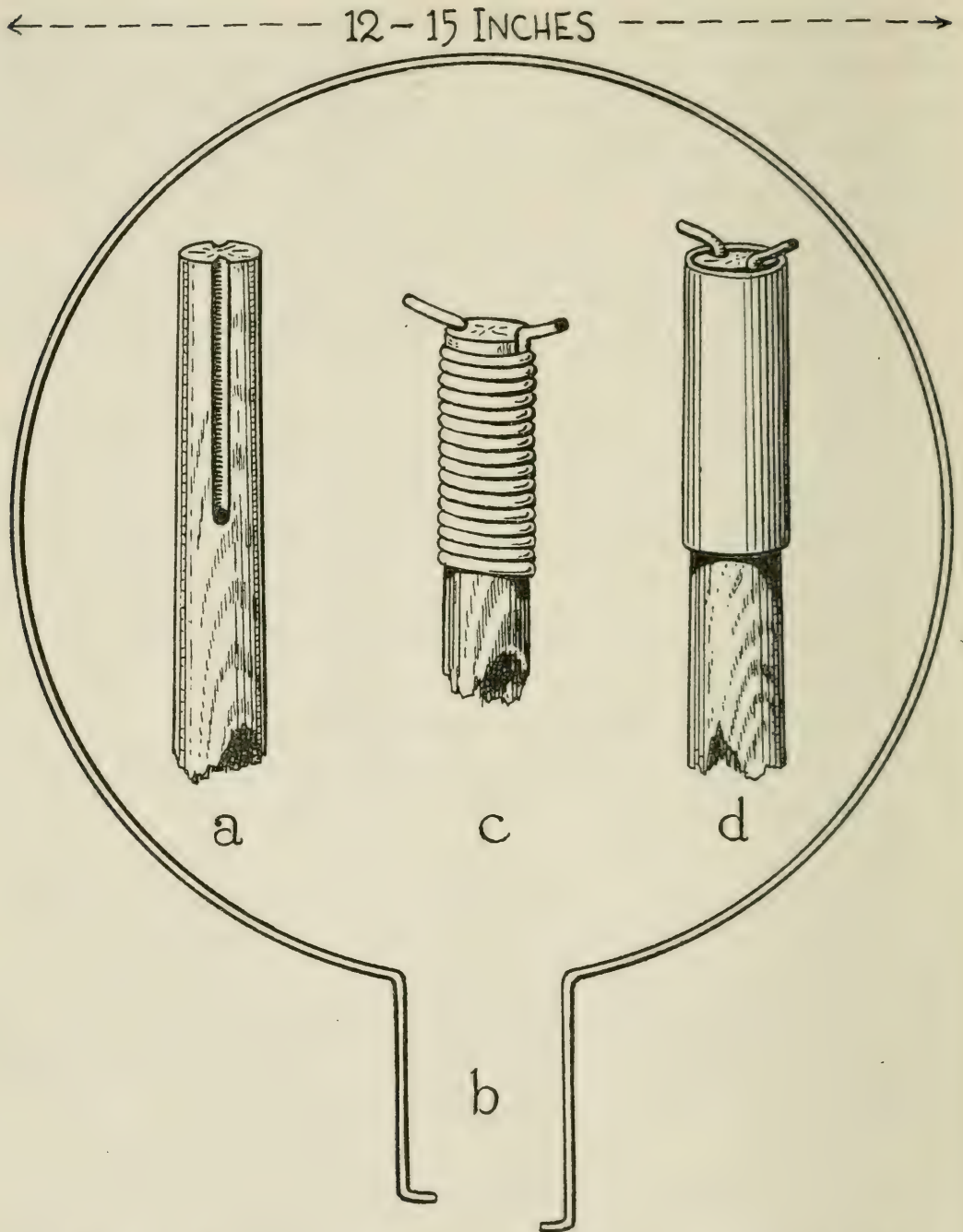


Fig. 1.—THE NET. The short grooves cut opposite each other at the small end of the handle, *a*, end in holes through the handle which receive the hooks of the ring arms, *b*. The ring may be permanently bound to the handle with wire, *c*, or a removable joint may be effected with a metal ferrule that can be slipped up and down, *d*.

inches; and each ends in a hole through the handle at right angles to the length. The ring (Fig. 1, *b*) is made of steel

wire, preferably three-eighths inch piano wire, which if bent by rough usage springs back into shape and will stand a great deal of hard wear. The wire is shaped as the figure shows, to form a ring with two straight arms which at the tips are bent at right angles towards each other. The arms and hooks thus formed must be exactly long enough to fit along the grooves and into the holes in the handle. After the wire has been fitted to the handle and the bag or net properly attached, the joint may either be wrapped tightly with wire (Fig. 1, *c*) or bound by a metal cylinder or ferrule slipped up over the arms of the ring (Fig. 1, *d*).

The bag (Fig. 2) should be tapered at the bottom and about twice as long as the diameter of the ring. It is made from four pieces of cloth cut in the shape of Fig. 2, *a*, and a narrow strip of stout muslin or light canvas, *b*, which binds the bag to the ring. The four pieces are sewn together into the cone shaped bag, and to the circular opening is sewn the canvas or muslin band.

The bag may be attached to the handle in two ways. The band may be folded over the ring and sewn down so that the attachment is permanent; or it may be made into a loop and slipped on the ring before the latter is fastened to the handle. In the latter case the bag must be open along one seam just below the handle a sufficient distance to allow the band to slip on and around the ring; this vent may be closed with a string lacing after the loop is on the ring and the whole fastened to the handle. A combination of this arrangement with a ferrule binding the ring to the handle is most convenient for it allows the bag to be removed at will and a lighter or heavier one substituted according to the needs of the collector.

Nets made from the following materials will be found to cover all the demands of the average collector.

1. *General purpose net*.—Ring, heavy wire, 12 inches in diameter; bag, strong unbleached muslin

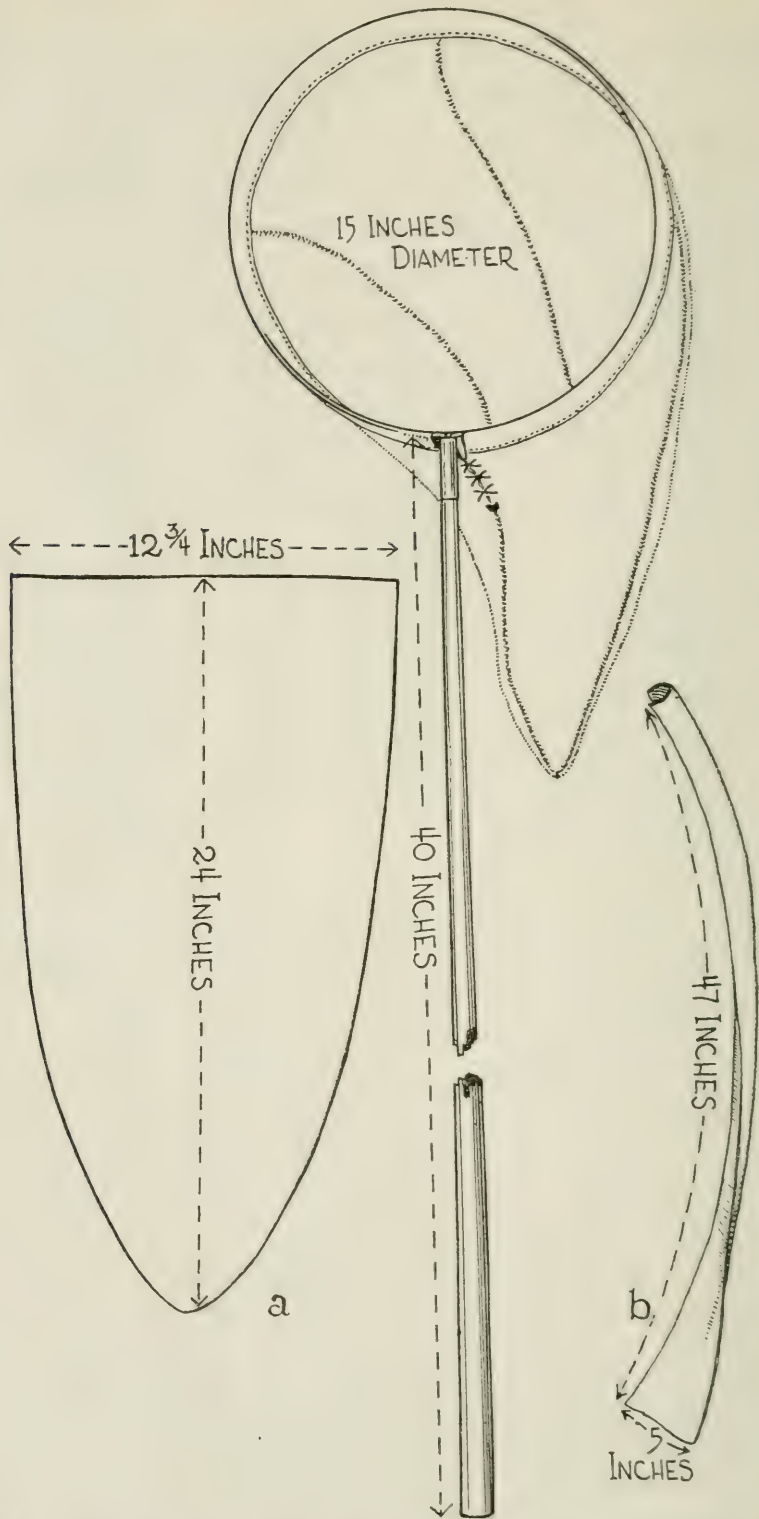


Fig. 2.—THE NET. The bag is cut from four pieces shaped as in *a*, and the circular opening at the top of the bag is bound with a narrow strip of stout muslin or light canvas, *b*, by means of which the bag is attached to the ring.

or light duck, 20-24 inches long; handle, hardwood stick 24-30 inches long.

2. *Butterfly net*.—As above but with a longer handle and a bag of good quality marquisette or fine netting.

A net which includes the features and uses of these two and is a better collecting instrument may be a convenient one for the collector to make instead, although at slightly higher cost because of the better materials. Its ring, of $7\frac{1}{2}$ gauge (three-eighths inch) piano wire, is 15 inches in diameter and allows a greater area to be covered with each sweep. The bag, of finest bolter's silk or best quality marquisette, is 24 inches long and serves equally well for the capture of delicate insects and for beating. The handle, of straight grained hickory or ash, is 40 inches long and also permits the collector to cover greater areas in sweeping.

Their Care and Use.—All nets are easily ripped and for this reason keep them away from barbed wire and thorny trees such as locust and red haw. Keep the nets dry. Moisture rots the fabric, making it more easily torn, and in addition ruins almost all insects caught in the net while it is wet.

Flowers, herbs and boughs should be swept with a side-wise motion. This will get more insects than an upward or downward sweep and at the same time mutilate the plant less. If care is taken the same patch of flowers or other plants may be visited several times with profit. The contents of the bag should be removed after every few strokes or sweeps. This will avoid damage to the insects by banging around in the net with a large amount of debris.

KILLING BOTTLES

Their Construction.—The best killing bottles are made with cyanide of potassium, sodium or calcium. These compounds give a concentration of deadly fumes sufficient to

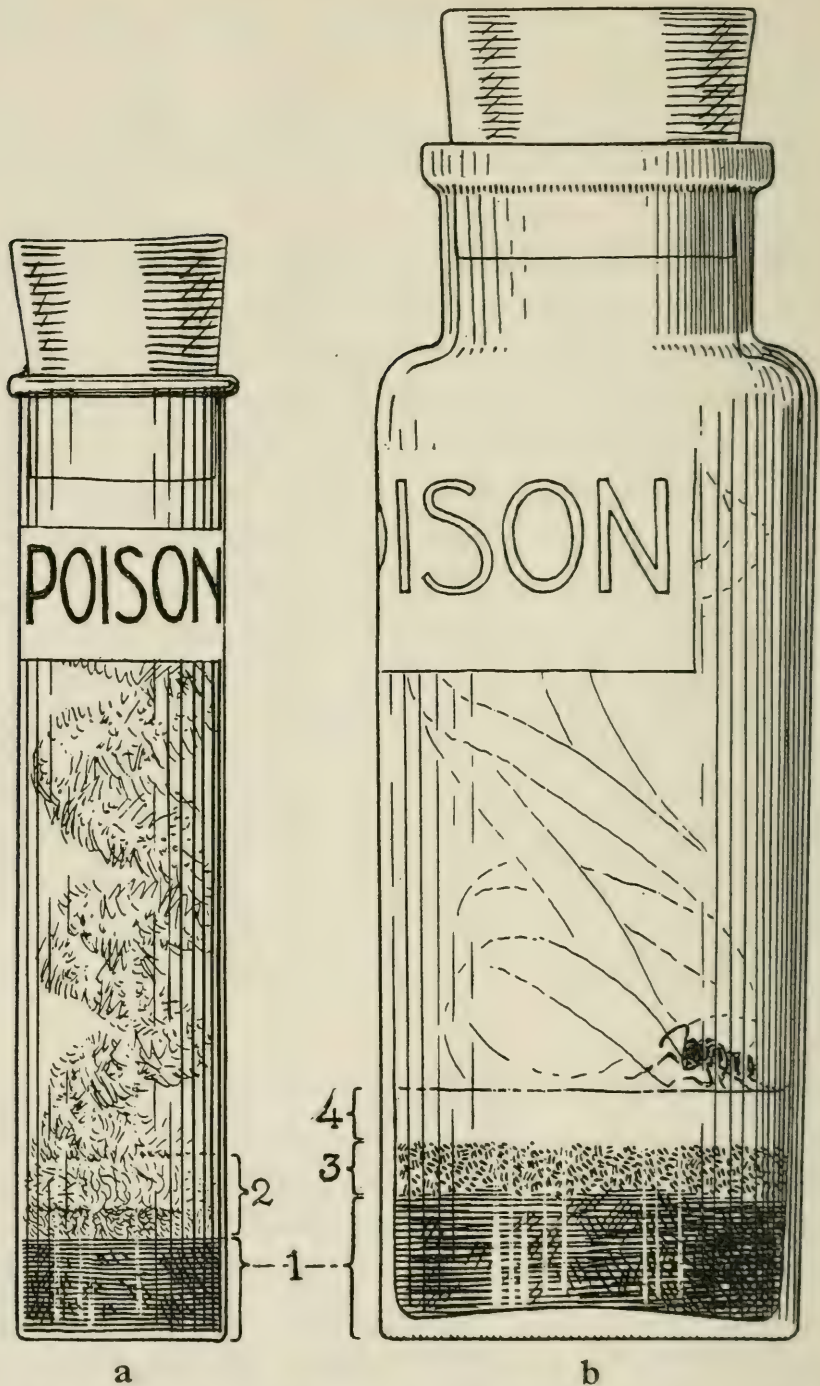


Fig. 3.—CYANIDES. Killing bottles of at least two sizes should be included in every collector's equipment. The lethal chemical, 1, is cyanide of potassium, sodium or calcium, and is covered with a layer of cellucotton, 2, or sawdust, 3, and plaster of Paris, 4. The rest of the bottle is filled with soft, loosely crumpled paper, which should be changed whenever it gets damp. Keep the bottles tightly corked, do not test their strength by smelling, and label them POISON.

kill most insects in a very short time, which is desirable. Two general sizes of bottles are used and in both calcium cyanide in flake form gives good results.

Pyrex glass test tubes or strong ring necked vials, about three-quarters of an inch wide and 4-6 inches long, make good cyanide bottles (Fig. 3, *a*). Put about three-quarters of an inch of granular potassium cyanide or calcium cyanide flakes in the tube. Cover with a tight plug of cellucotton on top of which put one or two looser plugs. Instead of cellucotton, sawdust and a plaster of Paris batter may be used. Cover the cyanide with one-quarter inch of sawdust and over it pour one-quarter inch of newly mixed, thick batter of plaster of Paris and water. Allow this to harden for a few hours, then keep tightly corked.

Larger cyanides (Fig. 3, *b*) should be made in strong bottles, in sizes of pickle bottles up to quart fruit jars, and *always with the plaster of Paris covering*. The layer of sawdust and plaster should be a little thicker than for the smaller bottle. Rock sodium cyanide may be used if preferred or if more convenient than calcium cyanide flakes.

All killing bottles and other containers of cyanide should be conspicuously labeled POISON, kept tightly corked and away from children or people who do not realize the extreme deadliness of the compounds. *Never test the strength of killing bottles by taking the cork out and smelling the inside of the tube or bottle.* As an added precaution and safeguard to the collector the bottom of the cyanide bottle may be taped to protect it from chance blows.

The bottles should be almost entirely filled with loosely crumpled soft paper which should be changed whenever it gets damp. It will help to keep specimens from rubbing and defacing each other inside the bottle.

Their Care and Use.—Each collector should have several cyanides and follow carefully these practices.

1. *Keep small delicate insects in a bottle by themselves.* Such insects as large beetles are apt to mutilate small flies, etc., in the same bottle.

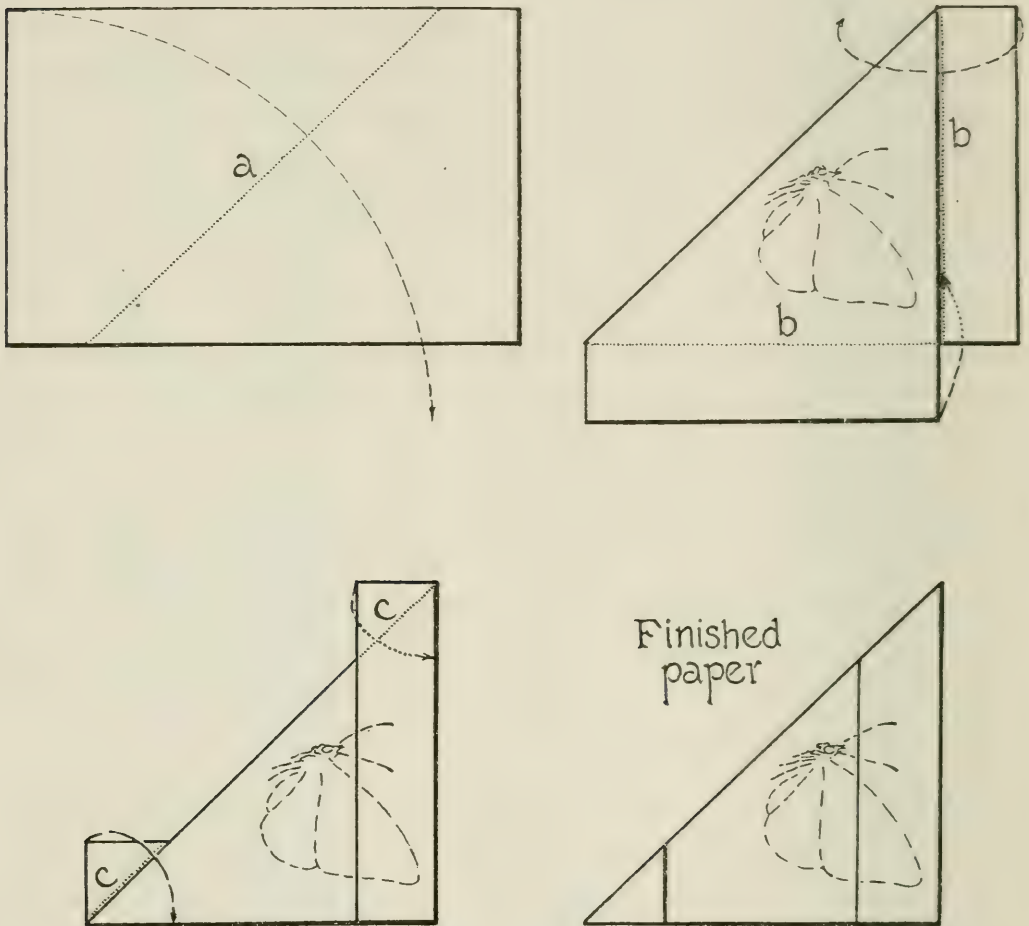


Fig. 4.—PAPERS. These are temporary means of keeping dragon flies, moths and butterflies until they can be relaxed and mounted. A rectangular piece of paper, varying in size according to the insect it is to contain, is folded along the dotted lines of the figure, from *a* to *c* and in the directions of the arrows.

2. *Keep a special bottle for moths and butterflies.* When these die they shed large quantities of scales which stick to and partially spoil other insects.

3. *Keep the inside of the bottle dry.* Cyanides “sweat;” that is, moisture both from the insects and the plaster condenses on the inside of the bottle.

This will mat the hair and appendages of insects and discolor the body.

4. *Take the insects out of the bottles as soon as they are dead.* Cyanide fumes soon turn many yellows to red or orange, and also make small specimens brittle so that legs and other parts break off easily.

5. *Empty the insects out of the bottles before they have accumulated in a ball at the bottom.* This will prevent damage to the smaller specimens and discoloration due to "sweating."

6. *Discard a cyanide bottle which no longer kills quickly.* Substitute a fresh one and you will save untold time in the field. Be sure to dispose of old bottles so that their deadly contents will be out of reach of children and pets.

HOW TO HANDLE UNMOUNTED SPECIMENS

TEMPORARY CASES

IF it is not convenient to mount the specimens when they are taken from the killing bottle the moths and butterflies should be put in "papers" and the other insects in "cotton."

Papers are simply rectangular strips of paper of convenient size folded as in Fig. 4. The moth or butterfly with its wings folded is placed in the paper whose edges are then crimped over to lock it shut.

For other insects pill boxes or small flat tins make good temporary housing. A layer of cellucotton is laid in the bottom, a layer of insects placed on it and another layer of cotton placed over the insects. The lid should fit fairly snugly over all. Cigar boxes and others of like size may be used in the same way for larger collections.

Great care must be taken that sufficient cotton is put in the box to take up all moisture in the insect bodies. If the

specimens are large they should be allowed to dry moderately before being put in cotton, and placed in a wood or cardboard container which will not sweat, as will a metal box. If the insects become damp in these containers they quickly mold or rot. They should be packed tight enough to prevent their rolling around and breaking.

RELAXING BOXES

At any desired time these dry specimens may be relaxed and mounted. A relaxing box or jar is easily made. Take a wide mouthed tin or jar, put an inch or two of clean sand in the bottom, saturate this with water containing a small amount of phenol (carbolic acid) and place over it a piece of cork, cardboard or wood cut to fit the jar. The lid must be practically air tight. Place the dry specimens on the cork, cover tightly, and in a day or two they will be soft and pliable enough for pinning or spreading, the next steps toward permanent arrangement of the collection.

The relaxer will sweat badly if kept in too hot a room, and spoil the specimens. The insects will be equally spoiled if left in the relaxer too long. This is a matter varying with each relaxer and can be learned only by experience.

HOW TO MOUNT AND PRESERVE THE COLLECTION

ALMOST all adult insects are mounted on pins. Such insects as beetles, grasshoppers, butterflies, moths, flies, bees, etc., are pinned directly through the body from top to bottom. Small insects such as leafhoppers, plant bugs, small beetles and the like, are glued on card points. Immature insects and the adults of some groups are best preserved in fluid.

PRESERVATION IN FLUID

Caterpillars and other immature stages of insects should be preserved in fluid. Grain alcohol at 80 per cent or formaldehyde at 4 per cent are suitable. Caterpillars, grubs and

maggots should first be heated five or ten minutes in water just at the boiling point. This sterilizes the specimens and prevents their discoloration by bacteria in the digestive system.

Soft bodied adult insects should also be preserved in

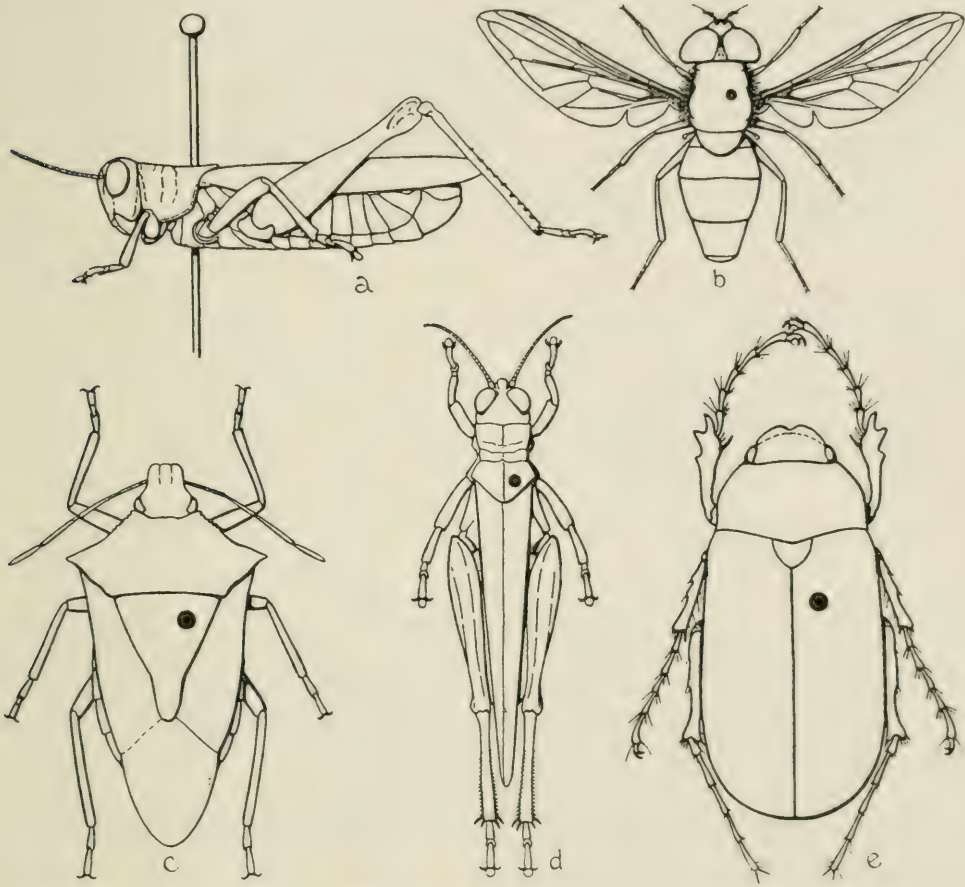


Fig. 5.—PINNING. Medium to hard shelled insects are mounted by being pinned through the body in the manner shown at *a*. The black spots show the location of the pin in the case of bees, flies and wasps, *b*, stink bug, *c*, grasshoppers, *d*, and beetles, *e*.

fluid. If pinned they shrivel to such an extent that few identifying characters can be seen. This is especially true of insects which develop in rivers, lakes and streams, such as stoneflies and caddice flies. The fluid in the vials of all insects so preserved should be changed at the end of the first day or two.

Some hard shelled insects may also be preserved in fluid. Ants and beetles may be treated thus temporarily and later pinned and dried.

PRESERVATION BY PINNING

Hard bodied insects such as beetles, flies and wasps are preserved as dry specimens on pins better than in fluid. The pinned specimens are more convenient to study and retain their natural coloring better. Flies and butterflies are covered with hairs or scales which clot or break off if

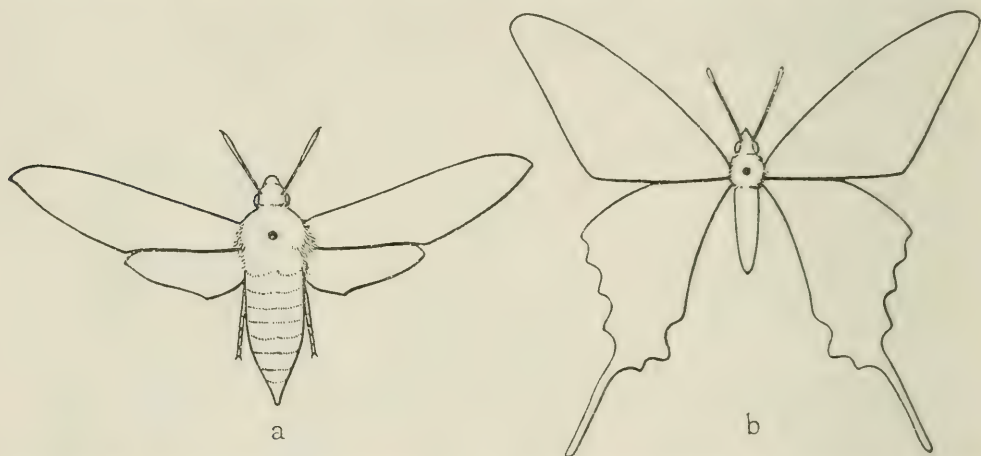


Fig. 6.—PINNING. Moths, *a*, and butterflies, *b*, are pinned through the center of the thorax (instead of to the right of the median line) between the bases of the front wings.

the specimens are bottled, and for this reason they should be pinned.

Common household pins are too thick and short for pinning insects. Longer and more slender pins are necessary, and may be purchased from various supply houses. They should be of spring steel; brass pins will corrode and be destroyed by acids in the insect's body. The pins are obtained in numbered sizes, of which 2, 3 and 4 will be found of most general use, and sizes 0 or 00 of advantage in certain other operations.

Medium to large hard shelled insects such as moths, beetles, flies, bees, wasps, etc., should be pinned vertically

through the body (Fig. 5, *a*). It is essential that the pin pass through a fairly solid part of the body, and to insure this the following standard procedures should be adopted.

1. *Bees, wasps, flies, etc.*—Pin through thorax between base of front wings slightly to right of middle line (Fig. 5, *b*).

2. *Stink bugs.*—Pin just to right of middle line of the *scutellum* or large triangle between the base of the front wings (Fig. 5, *c*).

3. *Grasshoppers.*—Pin through back part of prothorax (the "saddle" behind the head) just to right of middle line (Fig. 5, *d*).

4. *Beetles.*—Pin near front margin of right wing cover near middle line (Fig. 5, *e*).

5. *Moths, butterflies, dragon flies, damsel flies.*—Pin through the center of the thorax between the base of the front wings (Fig. 6).

The insect should be run about three quarters of the distance up the pin, but not so close to the top that no room is left for easy handling of the pin with the fingers. It is better to have all insects the same distance from the top of the pin, and to insure a uniform height the collector should use a pinning block. This is a small piece of wood or metal usually in the form shown in Fig. 7, into the top of which are drilled holes slightly larger than the pin diameters. Or

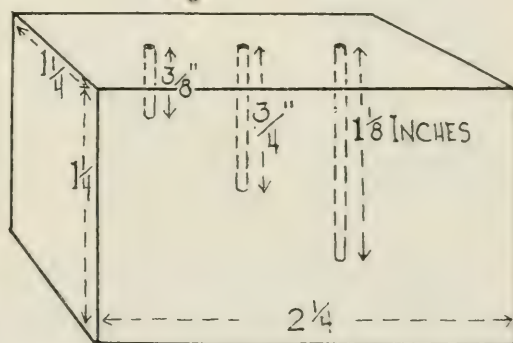


Fig. 7.—PINNING BLOCK. The block is $1\frac{1}{4} \times 1\frac{1}{4} \times 2\frac{1}{4}$ inches, with holes drilled to the depths shown and having diameters only slightly greater than the largest pin which will be used. A specimen is pinned and the pin inserted into one of the holes until it touches bottom; thus the insects of any class or in any case may be pinned uniformly at the desired height.

a home made block may be fashioned of wood with holes made by small nails and covered with a cardboard square through which have been stabbed holes of the exact size. The depths of the holes should be three-eighths, three-quarters of an inch and $1\frac{1}{8}$ inches, respectively. To use the block, pin the insect and insert the pin into whichever hole allows the specimen to be pushed up the pin and still leave room for handling at the top, according to the thickness of the insect's body.

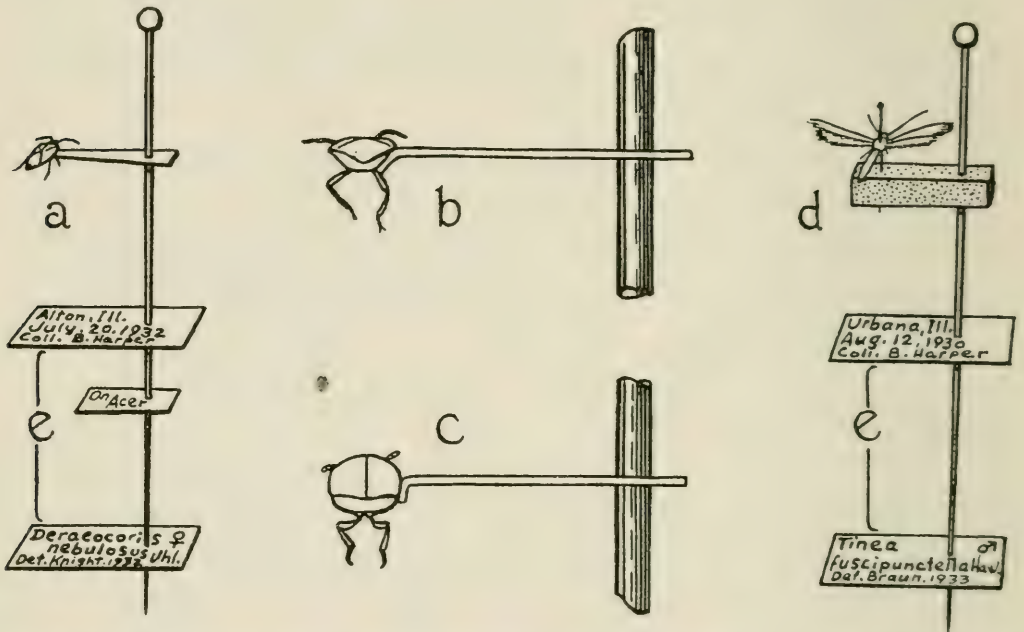


Fig. 8.—PINNING SMALL INSECTS AND LABELING. The insect may be glued to a card point, *a*, which has been crimped over to meet the right side of the body, *b*, *c*; or it may be pinned with a “minuten” pin, *d*, to a piece of cork or pith which in turn is regularly pinned. All pinned insects should be labeled, as at *e*.

Tiny Insects.—Very small insects, of which many will be encountered, cannot be pinned through the body as the pin will break too many of the insect's parts. Instead they are mounted on card points or “minuten” pins.

Card points are small triangles of cardboard or celluloid pinned through the larger end and crimped over at the smaller; a spot of good glue is put on the angled tip and the

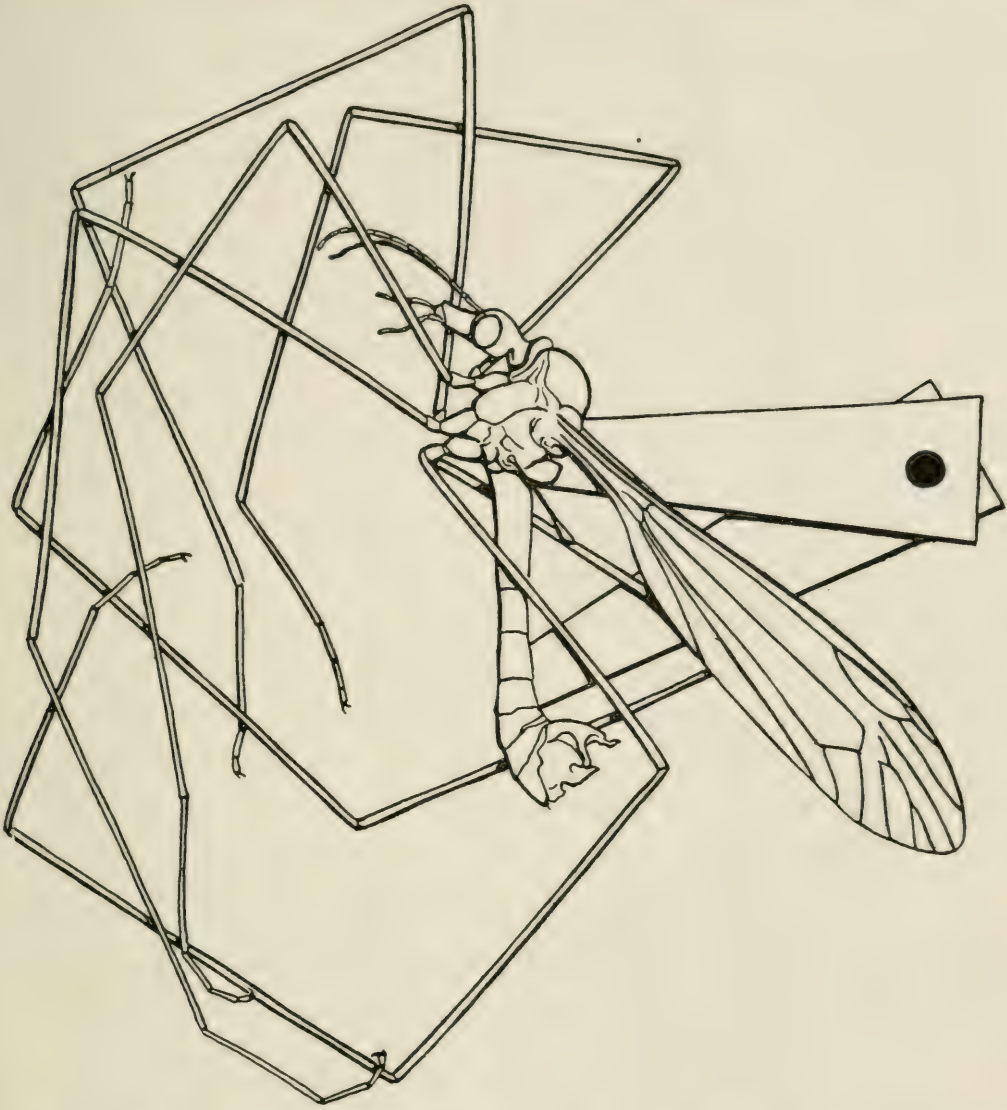


Fig. 9.—PINNING CRANE FLIES. Because of their unwieldy legs these insects should have a double card point mount, and the legs should be kept away from the pin.

right side of the insect is pressed against the glued surface (Fig. 8, *a*, *b*, *c*). The slant of the crimp depends on the angle of the insect's side, as the desired product is the insect mounted with its top surface horizontal and the head forward; legs, wings and antennae should be in view and as little of the body as possible hidden by the glue or card point. Use very little glue—a small amount holds well and gives a better specimen for study. The points may be cut

uniformly with a hand punch, about three-eighths of an inch long. Good material for them is 2 ply pasted Bristol board.

Minuten pins are short, extremely delicate steel pins (Fig. 8, *d*). These are thrust through the body of the insect and into small pieces of cork, pith or similar substance, which are in turn pinned in the regular way that card points are. The method is especially desirable for minute moths.

Insects Hard to Pin.—Wasps, lace wing flies, damselflies and like insects have an abdomen that sags readily when the specimen is killed and pinned. This unwanted drooping can be prevented in three simple ways. (1) Stick the pinned insect in a vertical surface of a block so that the body by its own weight dries in normal position. (2) Pin the insect horizontal and run a stiff paper on the pin beneath the body and supporting it naturally until dry. (3) Brace the abdomen by crossing two pins beneath it and thrusting them into the block, allowing the specimen to dry in the angle of the cross.

Crane flies are unwieldy and so best pinned on a double card point mount (Fig. 9). The legs should be directed away from the pin to avoid breakage in handling.

SPREADING MOTHS AND BUTTERFLIES

Moths and butterflies should have their wings spread before being put into the collection. To do this well it is necessary to have *spreading boards* which are accurately made but not necessarily complicated or expensive.

Their Construction.—A convenient board for medium sized insects can be made at home of the following materials.

1. A hardwood base $4 \times 12 \times \frac{1}{4}$ inches.
2. Two hardwood end pieces $4 \times \frac{3}{4} \times \frac{1}{2}$ inches.
3. Two softwood top pieces $1\frac{7}{8} \times 12 \times \frac{1}{2}$ inches, with the top surface planed at an angle, so that the thickness at one edge is $\frac{1}{2}$ inch and at the other $\frac{3}{8}$ inch.

4. Two flat cork pieces $1 \times 11 \times \frac{3}{16}$ inches.

Nail the top pieces onto the ends so that the slanting surfaces of the tops are uppermost and the narrower edges parallel and one-quarter inch apart (Fig. 10). Glue one

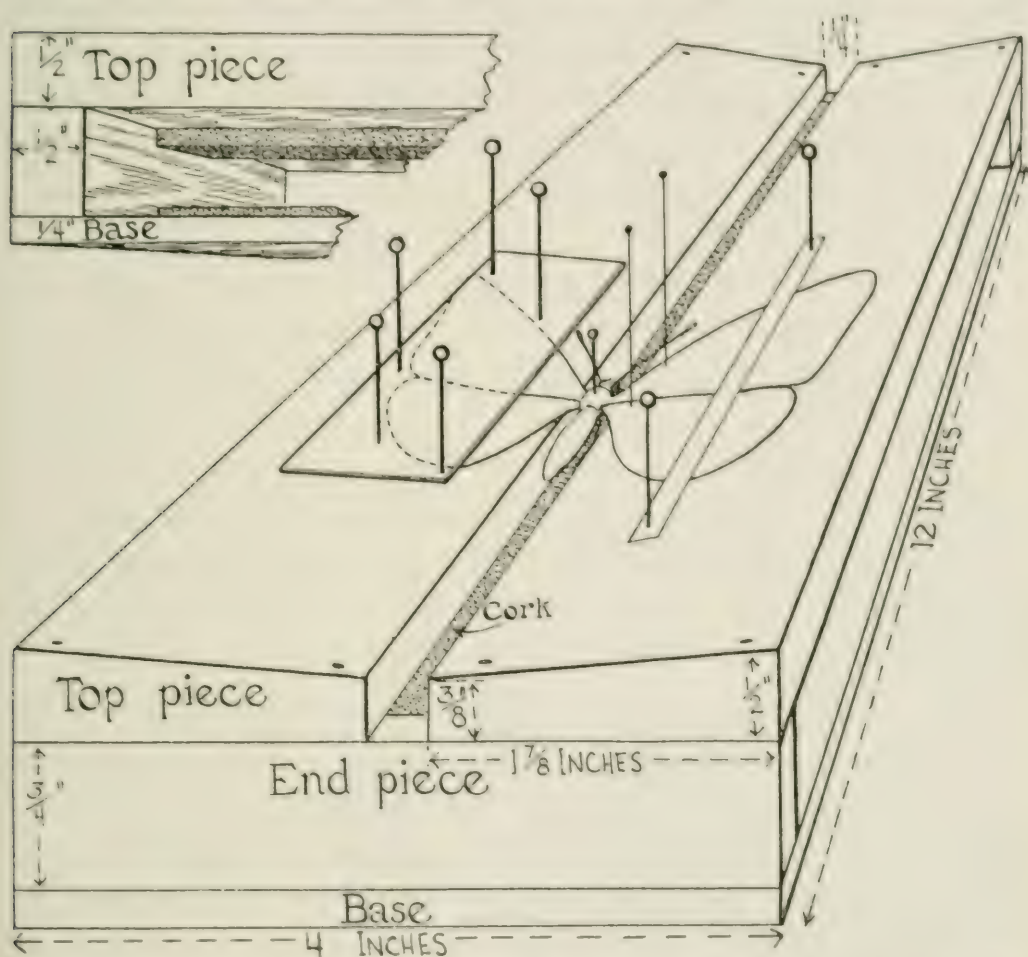


Fig. 10.—SPREADING BOARD FOR MOTHS AND BUTTERFLIES. The insect is pinned into the groove and its wings drawn forward and pinned temporarily as shown on the right. The left wings are shown with pinning completed. Inset is a view of spreading board construction.

strip of cork beneath the tops, covering the opening between and fitting snugly at each end. Glue the other cork piece flat to the upper side of the base, lengthwise along the middle and extending to within one-half inch of each end. Finally nail the base across the bottoms of the end pieces, so that the two corks face each other.

Their Use.—To spread the specimen, relax it, then pin. Thrust the pin through the upper cork of the board and into the cork on the base. Push the insect into the groove until the wing bases are level with the near edge of the top pieces. Hold the wings at the top level by two narrow strips of paper and pull them forward until the hind margin of the front wing is at right angles to the body axis, and the front margin of the hind wing is just under the front wing (Fig. 10). Pin the wings temporarily in this position by inserting a pin, size 0 or 00, near the front margin at the base of each wing. When the wings on both sides of the insect are thus adjusted, lay strong pieces of paper over them and pin down securely with large pins inserted close to the wings but not through them. Here large common pins may be used but still better are the large headed dressmaker's pins about $1\frac{1}{4}$ inches long. The original adjusting pins are finally removed and the specimen put in a dry, pest proof container for two or three weeks. It will then have set sufficiently to be removed from the board.

For good results spreading boards with grooves of various widths are necessary, and a specimen should be spread on that board whose groove most perfectly fits the insect body. The width of the top pieces should vary to accommodate different wing spreads. Their slope should be about as described.

HOW TO LABEL THE SPECIMENS

To be useful to the entomologist and others interested in the scientific relations of insects, as well as furnish the collector with a complete record of his hours in the field and make more valuable the work he has already accomplished, the specimens should be labeled. The important information to be put on the label is the locality and date of capture, but greater value will be attached to the specimen from a scientific point of view by adding the name

of the collector, the host on which the insect was found, or its particular habitat preference.

Labels should be made of a good grade of white paper stiff enough to hold a flat surface when cut up and raised on a pin. Most satisfactory is a substance 36 ledger. The labels may be printed by hand with a crow-quill pen and black India ink, or they may be purchased completely or partially printed from a biological supply house.

Keep the labels as small as possible, and of nearly a uniform size. They should be run about half way up the pin but not too near the specimen (Fig. 8).

HOUSING THE COLLECTION PERMANENTLY

INSECT BOXES

After the specimens have been pinned and labeled, they should be housed in boxes or cases having a soft bottom or inner layer which will allow easy pinning. Such housing not only insures the safety of the collection but makes for easily handled units once the specimens have been named.

Several satisfactory types of boxes for housing insect specimens may be bought from commercial supply companies. These are usually much better than boxes of home construction, being more dust and pest proof. Home made boxes, however, are quite practical for the beginning collector, due to their ease of construction and extremely low cost. Cigar boxes 2 inches deep or more make ideal boxes if a layer of cork, balsa wood or two layers of soft corrugated cardboard are glued in the bottom. Other wooden or cardboard boxes may be provided with such a bottom pinning surface and used for storing specimens. Boxes of this type, however, afford the specimens no protection against pests and great care must be exercised in keeping the boxes fumigated.

Manufactured boxes, cabinets and cases may be selected

from catalogs which various firms send free upon application.

PRECAUTION AGAINST PESTS

Certain insects such as flour beetles and carpet beetles feed upon dried insects, and unless precautions are taken these may entirely destroy a collection. To guard against them, various chemical repellents in cones or bags may be placed in the boxes of specimens. Naphthalene, of which ordinary moth balls are composed, is one of the best. A few moth balls may be put in a bag and this pinned securely in one corner of the box, or more neatly, naphthalene cones may be made of the moth balls and pins, and stuck in the corners. To make the cones, stick a pin in a cork, heat its head in a flame and then push it into a moth ball. The pin will melt its way into the naphthalene, which will cool and harden again almost immediately. Neat cones (Fig. 11) can with a little practice be made in this way.



Fig. 11.—
NAPHTHA-
LENE CONE.
Made with
a moth ball
and com-
mon pin.

Naphthalene is a repellent only; its odor keeps out pests, but if they are already in the collection the naphthalene will not kill them, and some other substance must be used.

Paradichlorobenzene, called P D B, is a good fumigant to use on pests in the collection. It should be used in a nearly air tight chamber, such as a tight trunk, bin or case, at the rate of 1 lb. of P D B to 25 cubic feet of space. The boxes of specimens, with lids open or removed, should be placed in the container, the fumigant on a piece of cloth or paper above them, and the chamber sealed for about a week.

IDENTIFYING THE SPECIMENS

There is a considerable number of books which will be

great help to the beginner in naming his specimens. The following are perhaps the more easily used, though others are being published from time to time.

1. Comstock, J. H. *An Introduction to Entomology*. The Comstock Publishing Company, Ithaca, N. Y. \$6.00.

2. Holland, W. J. *The Butterfly Book*. Doubleday, Doran & Company, Garden City, N. Y. \$10.00.

3. Holland, W. J. *The Moth Book*. Doubleday, Page & Company, Garden City, N. Y. Out of print but may be obtained from second hand book dealers; original price \$6.00.

4. Lutz, Frank E. *Field Book of Insects*. G. P. Putnam's Sons, New York, N. Y. \$3.50.

5. Metcalf, C. L., and W. P. Flint. *Destructive and Useful Insects*. McGraw-Hill Book Company, 370 Seventh Avenue, New York, N. Y. \$7.50.

6. Morgan, Ann Haven. *Field Book of Ponds and Streams*. G. P. Putnam's Sons, New York, N. Y. \$3.50.

Specimens which the collector is unable to name should be sent to specialists or entomological museums for determination. The arrangements under which these authorities will undertake the work vary, but commonly they will study well preserved and labeled collections in return for duplicate specimens which they may keep. However, the identification of many insects is difficult and laborious so that rapid service is not always to be expected by collectors sending in material.

HOW TO SHIP THE COLLECTION

The collection needs special preparation and care to guard against breakage if it is to be shipped to an authority for determination.

See that all pins are thrust securely into the cork on

the bottom of the box. Thrust extra pins of the same height in each corner and over the whole lay a piece of thin cardboard which has been cut to fit the inside of the box snugly, then place over this a layer of cotton wool or cellucotton thick enough to press firmly against the cardboard when the top is closed. Wrap the box in paper and then pack it in a larger box, protected on all sides by a layer of excelsior or crumpled paper at least 2 inches thick.

WHERE TO GET SUPPLIES

1. American Entomological Company. Brooklyn, N. Y.
2. Bausch and Lomb Optical Company. Rochester, N. Y.
3. Carpocapsa. 375 Lehigh Avenue, East Liberty Station, Pittsburgh, Pa.
4. Central Scientific Company. 460 East Ohio Street, Chicago, Illinois.
5. E. Leitz, Inc. 60 East Tenth Street, New York, N. Y.
6. General Biological Supply House (Inc.). 761-763 East Sixty-ninth Place, Chicago, Illinois.
7. Spencer Lens Company. 5 South Wabash Avenue, Chicago, Illinois.
8. The Kny-Sheerer Corporation of America. 10-14 West Twenty-fifth Street, New York, N. Y.
9. Ward's Natural Science Establishment, Inc. P. O. Box 24, Beechwood Station, Rochester, N. Y.

THE ILLINOIS NATURAL HISTORY SURVEY CIRCULAR

WITH THIS ISSUE the Circular enters its second volume. The papers which were published in the Entomological Series (1918-1930), the Forestry Series (1920-26) and the Botanical Series (1929), as well as several papers issued without number (1918-1919), have been consolidated into a single series and renumbered in the order of their appearance. The separate series given above have been discontinued and henceforth the circulars will be numbered consecutively without grouping in reference to subject matter. The first 24 papers of the following list, which have been printed since 1918, are to be considered the contents of Volume 1 of the Circular. Numbers starred are out of print.

VOLUME 1, 1918-1932

1. The more important insecticides and repellents. W. P. FLINT. 6 pp. 1918. *Issued originally without number.*
- *2. Clean up the chinch-bug. WESLEY P. FLINT. 3 pp., 4 figs. 1918. *Issued originally without number.*
3. Forest and stream in Illinois. STEPHEN A. FORBES. 15 pp. 1919. *Issued originally without number.*
4. The danger from house-flies and how to control it. STEPHEN A. FORBES. 4 pp. 1919. *Issued originally without number.*
- *5. Method of destroying grasshoppers. W. P. FLINT. 11 pp., 7 figs. 1919. *Formerly Entomological Series Circular 3.*
6. The corn root-aphis. W. P. FLINT. 7 pp., 2 pls. 1919. *Formerly Entomological Series Circular 4.*
- *7. Chinch-bug barriers. W. P. FLINT. 9 pp., 4 figs. 1919. *Formerly Entomological Series Circular 5.*

VOLUME 1.—CONT'D

8. Concerning a forestry survey and a forester for Illinois. STEPHEN A. FORBES and ROBERT B. MILLER. 7 pp., 2 figs. 1920. *Formerly Forestry Series Circular 1.*
9. The European corn-borer. W. P. FLINT and J. R. MALLOCH. 7 pp., 6 figs. 1920. *Formerly Entomological Series Circular 6.*
- *10. The army-worm. W. P. FLINT. 9 pp., 4 figs. 1920. *Formerly Entomological Series Circular 7.*
11. Fire prevention in Illinois forests. ROBERT B. MILLER. 13 pp., 6 figs. 1920. *Formerly Forestry Series Circular 2.*
12. Method of destroying grasshoppers. W. P. FLINT. 11 pp., 8 figs. 1921. *Formerly Entomological Series Circular 3 Revised.*
13. Chinch-bug barriers. W. P. FLINT. 9 pp., 4 figs. 1921. *Formerly Entomological Series Circular 5 Revised.*
14. The army-worm. W. P. FLINT. 9 pp., 4 figs. 1921. *Formerly Entomological Series Circular 7 Revised.*
15. The peach borer and methods of control. W. P. FLINT and S. C. CHANDLER. 11 pp., 6 figs. 1922. *Formerly Entomological Series Circular 8.*
16. The fruit tree leaf roller and its control under Illinois conditions. W. P. FLINT and J. H. BIGGER. 12 pp., 4 figs. 1926. *Formerly Entomological Series Circular 9.*
17. Brownfield woods: a remnant of the original Illinois forest. C. J. TELFORD. 16 pp., 6 pls. 1926. *Formerly Forestry Series Circular 3.*
18. Wood as a crop in Illinois. C. J. TELFORD. 22 pp., 10 figs. 1926. *Formerly Forestry Series Circular 4.*
19. Habits and control of termites. AUGUST E. MILLER. 12 pp., 6 figs. 1926. *Formerly Entomological Series Circular 10.*

VOLUME 1.—CONCL'D

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20. Habits and control of termites. AUGUST E. MILLER.
12 pp., 7 figs. 1928. *Formerly Entomological
Series Circular 11 (Circular 10 Revised)*.
21. Peach Yellows in Illinois. L. R. TEHON and G. L.
STOUT. 24 pp., 9 figs. 1929. *Formerly Botanical
Series Circular 1*.
22. Greenhouse pests. C. C. COMPTON. 114 pp., 34 figs.
1930. *Formerly Entomological Series Circular 12*.
23. Habits and control of termites. AUGUST E. MILLER.
12 pp., 7 figs. 1931. *Formerly Entomological
Series Circular 11 Revised*.
24. Care of trees. L. E. SAWYER. 7 pp., 5 figs. 1932.
Formerly Forestry Series Circular 5.
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VOLUME 2

25. How to collect and preserve insects. H. H. ROSS.
27 pp., 11 figs. 1934.

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